Chapter 18
Configure Multilink Interfaces

The Multilink Protocol (MP) enables you to split, recombine, and sequence datagrams across multiple logical data links. The goal of multilink operation is to coordinate multiple independent links between a fixed pair of systems, providing a virtual link with greater bandwidth than any of the members. The physical connections must be E1 or T1 interfaces.

The Multilink Protocol includes two encapsulation types: Multilink Point-to-Point Protocol (MLPPP) and Multilink Frame Relay (MLFR); the JUNOS software supports both MLPPP and MLFR (FRF.15 only). The standards for MLPPP and MLFR FRF.15 are defined in the following specifications:

RFC 1990, *The PPP Multilink Protocol (MP)*

FRF.15, *End-to-End Multilink Frame Relay Implementation Agreement*

If you have at least one Multilink Services PIC installed in your router, you can use MLPPP or MLFR encapsulation. To configure multilink interface properties, include the ml-*fpc/pic/port* statement at the [edit interfaces] hierarchy level:

```
[edit interfaces]
ml-fpc/pic/port {
    unit logical-unit-number {
        drop-timeout milliseconds;
        encapsulation (multilink-ppp | multilink-framerelay);
        fragment-threshold bytes;
        minimum-links number;
        mrru bytes;
        short-sequence;
        family inet {
            address address {
                destination address;
            }
        }
    }
}
```

The Multilink Services PIC is not compatible with the M40e, M160, T320, and T640 platforms.

This chapter is organized as follows:

Configure Multilink Properties

You configure multilink interface properties at the logical unit level.

Default settings for multilink properties are described in the following section:

You can configure the following multilink-specific properties:

For general information about family inet properties, see “Configure Protocol Family and Address Interface Properties” on page 125. For information about multilink properties you configure at the family inet hierarchy level, see “Configure Physical and Logical Multilink Interfaces” on page 266.

Default Settings

Table 18 lists the default settings for multilink statements, together with the other values or value ranges permitted. For more information about specific statements, see the following separate sections.

Table 18: Multilink Bundle Statements

Option	Default Value	Possible Values
Drop timeout period	0 ms	0 through 127 ms
Encapsulation	multilink-ppp	multilink-framerelay, multilink-ppp
Fragmentation threshold	0 bytes	128 through 16320 bytes (*N*x64)
Minimum links	1 link	1 through 8 links
MRRU (maximum received reconstructed unit)	1524 bytes	1500 through 4500 bytes
Sequence ID format for ML-PPP	24 bits	12 or 24 bits
Sequence ID format for MLFR	12 bits	12 bits

Configure a Drop Timeout Period

By default, the drop timeout parameter is disabled. You can configure a drop timeout value to provide a recovery mechanism if individual links in the multilink bundle drop one or more packets. Make sure the value you set is larger than the expected differential delay across the links, although drop timeout is not a differential delay tolerance setting, and does not limit the overall latency.

To configure the drop timeout value, include the drop-timeout statement at the [edit interfaces ml-*fpc/pic/port* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces ml-fpc/pic/port unit logical-unit-number]
drop-timeout milliseconds;
```

milliseconds is the duration of the drop timer; its range is 1 through 127 ms. Values less than 5 ms are not recommended; a value of 0 disables the timer.

For multilink interfaces, if a packet or fragment encounters an error condition and it is destined for a disabled bundle or link, it does not contribute to the dropped packet and frame counts in the per-bundle statistics. The packet is counted under the global error statistics and is not included in the global output bytes and output packet counts. This unusual accounting happens only if the error conditions are generated inside the multilink interface, not if the packet encounters errors on the wire or elsewhere in the network.

Configure Encapsulation

By default, the encapsulation on multilink interfaces is MLPPP. MLPPP and Multilink Frame Relay (MLFR) are the encapsulation types used to transmit packets within the multilink interface; for more information, see “Configure the Encapsulation on a Logical Interface” on page 106.

To configure multilink encapsulation, include the encapsulation statement at the [edit interfaces ml-*fpc/pic/port* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces ml-fpc/pic/port unit logical-unit-number]
encapsulation (multilink-ppp | multilink-framerelay);
```

You must also configure the T1 or E1physical interface with the same encapsulation type.

Configure a Fragmentation Threshold

By default, the fragmentation threshold parameter is disabled. For MLPPP interfaces only, you can configure a fragmentation threshold to set a maximum size for packet payloads transmitted across the individual links within the multilink circuit. The software splits any incoming packet that exceeds the fragmentation threshold into smaller units suitable for the circuit size; it reassembles the fragments at the other end, but does not affect the output traffic stream. The threshold value affects the payload only; it does not affect the MLPPP header.

To ensure proper load-balancing:

For MLFR interfaces, do not include the fragmentation-threshold statement in the configuration.

For MLPPP interfaces, do not include both the fragmentation-threshold statement and the short-sequence statement in the configuration.

For both MLFR and MLPPP interfaces, if the MTU of links in a bundle is less than the bundle MTU plus encapsulation overhead, then fragmentation is automatically enabled. You should avoid this situation for MLFR interfaces and for MLPPP interfaces with short-sequencing enabled.

To configure a fragmentation threshold value, include the fragment-threshold statement at the [edit interfaces ml-*fpc/pic/port* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces ml-fpc/pic/port unit logical-unit-number]
fragment-threshold bytes;
```

bytes is the maximum fragment size, beyond which the software automatically subdivides packet payloads; its range is 128 through 16,320 bytes. Any value you set must be a multiple of 64 bytes (*N*x64). The default value of 0 results in no fragmentation.

Configure Multilink Minimum Links

You can set the minimum number of links that must be up for the multilink bundle as a whole to be labeled up. To set the minimum number, include the minimum-links statement at the [edit interfaces ml-*fpc/pic/port* unit *logical-unit-number*] hierarchy level:

```
minimum-links number;
```

By default, minimum-links has a value of 1. *number* can be a value from 1 through 8.

Configure MRRU

The maximum received reconstructed unit (MRRU) is similar to a maximum transmission unit (MTU), but applies only to multilink bundles; it is the maximum packet size that the multilink interface can process. By default, the MRRU is set to 1500 bytes; you can configure a different MRRU value if the peer equipment allows. The MRRU includes the original payload plus the 2-byte PPP header, but not the additional MLPPP or MLFR header applied while the individual multilink packets are traversing separate links in the bundle.

To configure a different MRRU value, include the mrru statement at the [edit interfaces ml-*fpc/pic/port* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces ml-fpc/pic/port unit logical-unit-number]
mrru bytes;
```

bytes is the MRRU size; its range is 1500 through 4500 bytes.

If you set the MRRU on a bundle to a value larger than the MTU of the individual links within it, you must enable a fragmentation threshold for that bundle. Set the threshold to a value no larger than the smallest MTU of any link included in the bundle.

Determine the appropriate MTU size for the bundle by ensuring the MTU size does not exceed the sum of the encapsulation overhead and the MTU sizes for the links in the bundle.

Configure Sequence Format

For MLPPP, the sequence header format is set to 24 bits by default. You can configure an alternative value of 12 bits, but 24 bits is considered the more robust value for most networks.

To configure a different sequence header value, include the short-sequence statement at the [edit interfaces ml-*fpc/pic/port* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces ml-fpc/pic/port unit logical-unit-number]
short-sequence;
```

For MLFR, the sequence header format is set to 24 bits by default. This is the only valid option.

Multilink Interface Structure

Each Multilink Services PIC can support a number of multilink *bundles* . A multilink bundle can contain up to eight individual *links*, such as T1 or E1 physical interfaces. Each link is associated with a logical unit number that you configure. You must configure a link before it can join a bundle. Each bundle should consist solely of one type of link; we recommend not mixing T1 and E1 physical interfaces within a bundle.

Multilink Services PICs are available in three versions, as shown in Table 19. The PIC hardware is identical, except for different faceplates that enable you to identify which version you are installing. The software limits the unit numbers and maximum number of physical interfaces you assign to the PIC. You can install a maximum of four Multilink Services PICs per router.

Table 19: Multilink Services PIC Capacities

PIC Capacity	Unit Numbers	Maximum Number of T1 Interfaces	Maximum Number of E1 Interfaces
4-bundle PIC	0 through 3	32 links	32 links
32-bundle PIC	0 through 31	256 links	219 links
128-bundle PIC	0 through 127	292 links	219 links

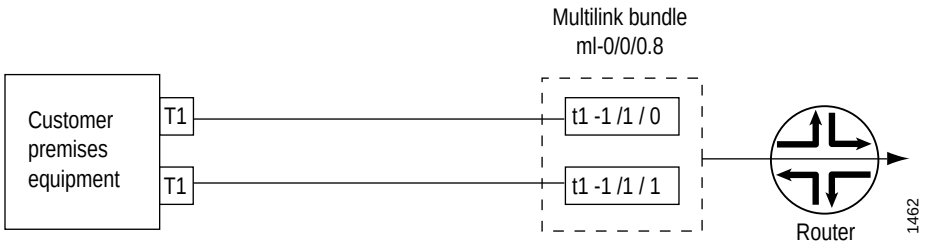
A single PIC can support an aggregate bandwidth of 450 Mbps.

You can configure a larger number of links, but the Multilink Services PIC can reliably process only 450 Mbps of traffic. A higher rate of traffic might degrade performance.

Configure Physical and Logical Multilink Interfaces

To complete a multilink interface configuration, you need to configure both the physical interface, either a T1 or E1, and the multilink bundle, which is a logical connection (see Figure 17). The physical interface is usually connected to networks capable of supporting MLPPP or MLFR.

Figure 17: Multilink Interface Configuration



Using the topology in Figure 17 as an example, configure a multilink bundle over a T1 connection (for which you have already configured the T1 physical interface) with the following additional configuration statements:

1. To configure a physical T1 link for MLPPP, include the following statements at the [edit interfaces t1-*fpc/pic/port*] hierarchy level:

```
[edit interfaces t1-fpc/pic/port]
unit 0 {
    family mlppp {
        bundle ml-fpc/pic/port;
    }
}
```

You do not need to configure an IP address on this link.

If the MLPPP bundle is interoperating with Cisco IOS, the IOS configuration must include the ppp multilink fragment-delay *milliseconds* statement within the interface multilink# configuration group:

interface Multilink#
ppp multilink fragment-delay *milliseconds*

milliseconds should be 500.

To configure a physical T1 link for MLFR, include the following statements at the [edit interfaces t1-*fpc/pic/port*] hierarchy level:

```
[edit interfaces t1-fpc/pic/port]
unit 0 {
    dlci dlci-identifier;
    encapsulation multilink-framerelay;
    family mlfr {
        bundle ml-fpc/pic/port;
    }
}
```

You do not need to configure an IP address on this link.

2. To configure the logical address for the ML-PPP bundle, include the address and destination statements at the [edit interfaces ml-*fpc/pic/port* unit *logical-unit-number* family inet] hierarchy level:

```
[edit interfaces ml-fpc/pic/port unit logical-unit-number]
    family inet {
        address address {
            destination address;
        }
    }
}
```

When you add statements such as MRRU to the configuration and commit, the T1 interface becomes part of the multilink bundle.

To configure the logical address for the MLFR bundle, include the address and destination statements at the [edit interfaces ml-*fpc/pic/port* unit *logical-unit-number* family inet] hierarchy level:

```
[edit interfaces ml-fpc/pic/port unit logical-unit-number]
    encapsulation multilink-framerelay;
    family inet {
        address address {
            destination address;
        }
    }
}
```

For MLPPP and MLFR links, you must specify the address as /32 or /30. Other subnet designations are treated as a mismatch.

Example: Configure Multilink Interfaces

These examples show only the multilink part of the configuration. For configuring the T1 options, see “Configure T1 Interfaces” on page 295.

Configure an MLPPP interface:

```
[edit interfaces]
ml-1/0/0 {
    unit 1 {
        fragment-threshold 128;
        family inet {
            address 192.128.5.1/32 {
                destination 192.128.200.200;
            }
        }
    }
    unit 10 {
        short-header;
        family inet {
            address 128.1.1.3/32 {
                destination 128.1.1.2;
            }
        }
    }
}
t1-5/1/0 {
    unit 0 {
        family mlppp {
            bundle ml-1/0/0.1;
        }
    }
}
t1-5/1/1 {
    unit 0 {
        family mlppp {
            bundle ml-1/0/0.1;
        }
    }
}
t1-5/1/2 {
    unit 0 {
        family mlppp {
            bundle ml-1/0/0.1;
        }
    }
}
```

Configure an MLFR interface:

```
[edit interfaces]
ml-1/0/0 {
    unit 1 {
        encapsulation multilink-framerelay;
        family inet {
            address 192.128.5.2/32 {
                destination 192.128.5.3;
            }
        }
    }
    unit 10 {
        encapsulation multilink-framerelay;
        family inet {
            address 128.1.1.3/32 {
                destination 128.1.1.2;
            }
        }
    }
}
t1-5/1/0 {
        unit 0 {
        dlci 10;
        encapsulation multilink-framerelay;
        family mlfr {
            bundle ml-1/0/0.1;
        }
    }
}
t1-5/1/1 {
    unit 0 {
        dlci 5;
        encapsulation multilink-framerelay;
        family mlfr {
            bundle ml-1/0/0.10;
        }
    }
}
t1-5/1/2 {
    unit 0 {
        dlci 6;
        encapsulation multilink-framerelay;
        family mlfr {
            bundle ml-1/0/0.10;
        }
    }
}
```